

Assessment of Online Interaction Patterns Using the Q-4R Framework

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Abstract

Online learning has merged into mainstream education as it allows learners to work at their own pace, get personalized attention and interact in a structured manner. The role of interaction is crucial in this process and various methods have been proposed in literature (Marcelo and Perera, 2007) to analyze its role in online learning. The purpose of this paper is to present findings on analysis of the linkages between interaction patterns, task given and facilitation methods in an online learning environment. A model of interaction patterns called Q-4R framework is proposed and, the experiences of 16 students of the Master of Instructional Design & Technology programme at the Open University Malaysia were studied. The flow of interactions in two comparable courses was explored for a period of two months each and evaluated. The study has thrown significant conclusions that can help us further understand the progression in interaction patterns over a period of time inadvertently aiding lifelong learning.

Keywords: Online learning, Interaction patterns, facilitation methods, asynchronous forums.

Introduction

In recent years, online education has emerged from being a support medium of instruction to being in the mainstream of education. The growth in communication technologies, increasing awareness about online education with the convenience of learning and the acceptance in the workplace are some of the key factors. Anywhere, anytime online education is not only a reality, it is showing great potential for effective learning, and interaction is the soul of online education. The key difference between success and failure in online teaching lies in the planned and structured interactions with the students. Interaction is an all-encompassing term that covers the pedagogical, instructional and personal aspects. From communication with the student about the goals and deliverables, interaction in planned forum

discussions and feedback about assignments to personal follow-up activities, the interaction activities are crucial to successful online teaching and learning.

Online Interaction

Online interactions have been the focus of a lot of research in recent years. Swann (2010) explains that any interaction in an online setting is in effect a dialogue and that the dialogue can further be classified as critical dialogue, creative dialogue, caring dialogue and reflective dialogue. The dialogue proceeds to elicit responses from students in four distinct aspects-information responsive: students explore the questions posed by the teacher; information active: students explore a topic by pursuing their own questions on a subject matter; discovery responsive: students pursue open questions framed by tutors and finally discovery active: students pursue the answers to their own open questions. The importance of this work is in the fact that it links the content of the discussion with the guidance mode in the discussion.

Hew and Chung (2008) proposed three phases of facilitation in online discussions, namely: (a) Establishing ground rules; (b) Engagement (share opinions/experiences, questioning, showing appreciation) and (c) Monitoring (suggesting new direction, summarizing and personally inviting people to contribute). The research proposed that facilitation methods must have these three phases for achieving learning goals. The convergence-divergence model as proposed by Xin (2008) was found to be equally effective in simulating online discussions. Convergence is a form of directed instruction where the aim is to coalesce the discussion towards the goal whereas divergence aims to introduce critical and divergent opinion to move towards the goal. Two distinct facilitation paradigms by Garrison (2007) which are widely cited are directed instruction and facilitated discourse. Directed instruction relies on the instructor taking a hands-on approach whilst facilitator discourse visualizes the instructors as guides.

Studies (Prasad, 2009; Bliss and Lawrence, 2009) have found that critical thinking is proportionate to instructor presence whereas Hou, Chang and Sung (2008) in a study of a forum without any teachers found that while the level of knowledge was adequate, there were limitations in the problem solving ability. Their recommendations were of timely intervention and encouraging learners to find their own solutions. Studies by An, Shin and Lim (2008) however showed that too much of instructor presence could stifle creativity among students. Thus, there is a lack of agreement on effect of instructor presence on critical thinking. Our belief is that this divergence may be due to the variance in the facilitation approach (a direct or indirect facilitator discourse). Thus, the important aspect to explore further in all the above is the quality of the critical thinking if the approach to facilitation varies.

2.1- Assessment of Online Discussion Forums

Allied to this aspect are the methods for assessing critical thinking in the asynchronous discussion forums. Asynchronous discussion forums are the lifeblood of online interactions. Dennen (2008) categorizes the measures for the assessment of participation in the discussion forums into five distinct aspects: (i) participation – who has participated and for how long; (ii) content - the quality of the content; (iii) structural – contribution to the community of learning in terms of the structure and linkages; (iv) micro ethnography – analysis in terms of the context of the discussion and (v) dialogue analysis – address the context, complexity and interrelationships of content in the prism of a dialogue. Zheng and Spires (2011) used social network analysis tools and postulate that for students to reach higher-order thinking in online discussions; the instructors must ensure that the students are challenged. In a group, while

participation metrics might be simplest to compute, the content based measures are opaque in terms of clear methods of measurement. The online facilitator needs to engage the learners (Kaur, Fadzil and Zoraini, 2010) by pacing interactions suitable to the time constraints faced by students, use appropriate questioning and feedback and provide direction & support to the learners.

The work by Schrire (2006) categorizes discussions in terms of interaction, cognition and discourse. Also, Blanchette (2011) focused on three methods to analyse the messages: (a) sequence analysis – based on message logs to determine the relationships between the messages; (b) surface cohesion analysis – the relationship between the messages in terms of the inter-message cohesiveness and (c) lexical cohesion – the grammatical and content cohesion. Here, the sequence measure is participation-based whereas the surface cohesion method and lexical cohesion method are content-based. The work by Marcelo and Perera (2007) considered three dimensions, namely cognitive, social and teaching.

According to Bliss and Lawrence (2009), the educational viable model metrics can be used to assess the quality of student postings whereas Bloom's taxonomy has been used by Meyer (2008) to assess the quality of online forums. Yang and Wu (2011) traced the patterns in terms of the roles that the student assumes – writer, editor and commentator. The thinking here is that any student will pass through these roles to achieve critical thinking, leading to life-long learning traits. The discussion forums are a snapshot of cooperative learning in the workplace. The approach to learning in discussion forums can in turn have an impact on the overall approach to life long learning by the students. The work by Rimor, Rosen and Naser (2010) categorizes interactions in terms of externalization, initiative, rapid consensus, integrative consensus and consensus through conflict. Their work found that nearly 50% of all the discussions were in terms of integrative consensus and consensus through conflict. Soller's taxonomy of Computer Supported Collaborative Learning (CSCL) has been modified in Song and McNary (2011) and an interesting aspect of this work was the support to the basic premise of our proposed work, viz. the type of the course matters in the interaction.

The question on the whole is how to assess the quality of interactions in the forums? What is the purpose of this assessment? According to Meyer (2006), there are two major needs of the assessment of forums, namely; as a grading measure and for guiding future methods in online facilitation. This research takes the latter approach with the additional aspect that feedback is a great learning mechanism for improved student learning. We are more interested in measures that will help make the methods of assessment better and this research has been designed keeping in mind Meyer's guidelines.

2.2 - The Proposed Online Interaction Assessment Framework

A core aspect of this work is that forum discussions can be measured quantitatively by using the Q-4R Framework with reference to the facilitation methods employed by an instructor. The purpose of defining a new framework is not just for the sake of research, but to address the core limitations of the existing frameworks. The existing and revised Bloom's Taxonomy is oriented only towards teaching and learning processes. Our experience shows that the dynamics of online discussion are different in that the discussions follow Read-Question- Synthesize- React-Redact-Recognize – Reflect cycle. That is, first the topic is read, then the learner questions the specifics in the topic or reacts based on first impressions. The next step is to apply the knowledge to specific constructs and ensure that recognition takes place (redaction). The learner also grapples with the different topics, views of the fellow learners and forms an internal opinion. The recognition stage is the precursor to the understanding where the internal opinion is consolidated, judgements are formed about the other opinions and the content is framed. The final stage is reflection where the ideas are synthesized, evaluated and opinions formed.

Using the above as guidelines in online learning, a framework called the Q-4R was derived from the revised Bloom's Taxonomy. A parallel is drawn between the four stages of the Q-4R (Table 1), Bloom's Taxonomy and the process of higher-order thinking in online discussions.

Table 1: A Comparison between the Q-4R Framework and Revised Bloom's Taxonomy

Revised Bloom's Taxonomy	Proposed Levels of the Online Discussion Framework
Information Gathering	Questioning, Reading, Reaction (restate, reframe)
Making use of knowledge	Application through examples, Recognition (breaking it down)
Application, Synthesis	
Judgement	Reflection (Synthesis), Self Evaluation, Judgement

The Q-4R framework is a unique feature of this work and can also be used as a tool for the assessment of online discussion posts. Using the Q-4R framework we can summarize that a student goes through a cycle of the following stages:

- **Question** - pose a query, request to clarify, probe, request the others to elaborate
- **Reaction** - name, reproduce, reframe, review, rewrite, summarize, define, identify, cite
- **Redaction** - breaks down; correlates; diagrams; differentiates; discriminates; distinguishes; focuses; illustrates; infers; limits; outlines; points out; apply, example
- **Recognition** - compares & contrasts; decides; interprets; judges; justifies; reframes; supports
- **Reflection** - creates; designs; devises; expresses; formulates; generates; incorporates; individualizes; models; validates.

The aim of this framework is to capture the critical stages in the evolution of learning and the model encompasses the cohesion, cognitive, social, role-based paradigm and the computer supported cooperative paradigms described in literature. Hence to validate this premise the Q-4R framework is compared with Bloom's Taxonomy as a part of this work to show the depth of our work and hopefully to validate the framework satisfactorily. The upper three levels of Bloom's Taxonomy and the upper two levels of the Q-4R framework are considered equivalent. Thus the higher-order thinking in the Q-4R framework is exhibited by the top two levels viz. recognition and reflection.

Generally, a facilitator's interaction method makes a big difference to the participation method by the online community. This work categorizes the facilitation method into two ways: guided and open ended. This is similar to the notions of direct instruction and facilitated discourse. In the guided learning style, the facilitator follows a plan with continuous interaction and guidance. The approach is hands-on and continuous whereby the content is presented and the questions are placed by the instructors. The discussions are focused on specific planned questions. The instructor summarizes the discussions and resolves agreement or disagreement. The open ended style is just-in-time and allows the group to flow and the facilitator intervenes only when it is needed. The planning is broad and specific to the group and the content varies from group to group. The learners are encouraged to find solutions and resolve the conflict themselves.

Objectives

The purpose of this research is to analyze the linkages between the interaction patterns and the facilitation methods used by two facilitators of a postgraduate programme, that is the Master of Instructional Design and Technology (MIDT) offered by the Open University Malaysia. The facilitators are highly respected professionals from across the world and enjoy a high degree of success in both academic and student satisfaction indices. The MIDT has been studied by 28 students from 14 different countries, 7 distinct time zones and a time frame of around 3 years. The challenge was to analyze the interaction patterns in terms of the facilitation method and answer the following questions:

- What is the correlation between the facilitation method and the patterns of interaction?
This question aims to analyze the pattern of interaction in terms of the context. Thus, the reasons for participation or lack of it thereof can be correlated. The question of whether a facilitation method enhances the participation is answered.
- What is the impact of the pattern of interaction and overall learning?
This question aims to see if learning can be categorized under patterns of interaction and analyze the impact in terms of overall achievement. Thus if a facilitation method enhances the participation, how effective is the learning then? Is the learning in terms of lower order (participation) or higher order (content and learning)?

Methodology

For this purpose two courses studied by the students of the MIDT programme (16 students) were taken as the base. The courses were facilitated by the two different facilitation methods. Totally, around 270 posts by 16 different students were analyzed in the study for a period of two months each.

The first course was guided in nature and was conducted from 4 February 2009 to 14 May 2009. A total of 137 posts were analyzed. Examples of tasks given were:

- Select one example of learning that you see at home, place of work or in public. Describe the learning and the steps involved in the learning. Which theory of learning explains this? Give an example of an instructional media (print, electronic or online) that can be used to support this theory of learning.
- The guideline given in this task is as follows. “This forum carries 10 percent of the total marks of the course. Marks will be based on the individual contribution and active participation. Please post at least one message in response to the issue and comment on at least two of your colleagues or other postings in this forum. Evaluation will be based on the postings until the closing date of the forum.”

The second course was open in nature and a total of 124 posts were evaluated from 5 March 2009 to 19 May 2009). Very minimal guidelines were given for the postings. Generally, students were given a topic to discuss till the target date.

Apart from the qualitative evaluation of the postings, a survey was conducted in July 2011 and in total 23 responses were collected about the two courses. These responses provide qualitative feedback on the

interaction patterns and the facilitation method. The conclusions of the work shed new light on the practices and principles of online interaction and facilitation methods.

The forum posts were assessed by two experts who knew the fundamentals of Bloom's taxonomy and Q-4R framework. The forum posts were assessed with reference to the task on hand. This is important because the need of the hour is not just to exhibit critical thinking, but critical thinking with respect to the task given. The experts had completed projects in the application of the Bloom's taxonomy and hence were well versed in the overall process. Each post was labeled against the Q-4R framework and Bloom's taxonomy and the categories derived by both experts. In case of conflict, the experts discussed and resolved the conflict.

Results

The responses in the Q-4R framework and Bloom's Taxonomy for the guided discussion are shown in Figure 1.

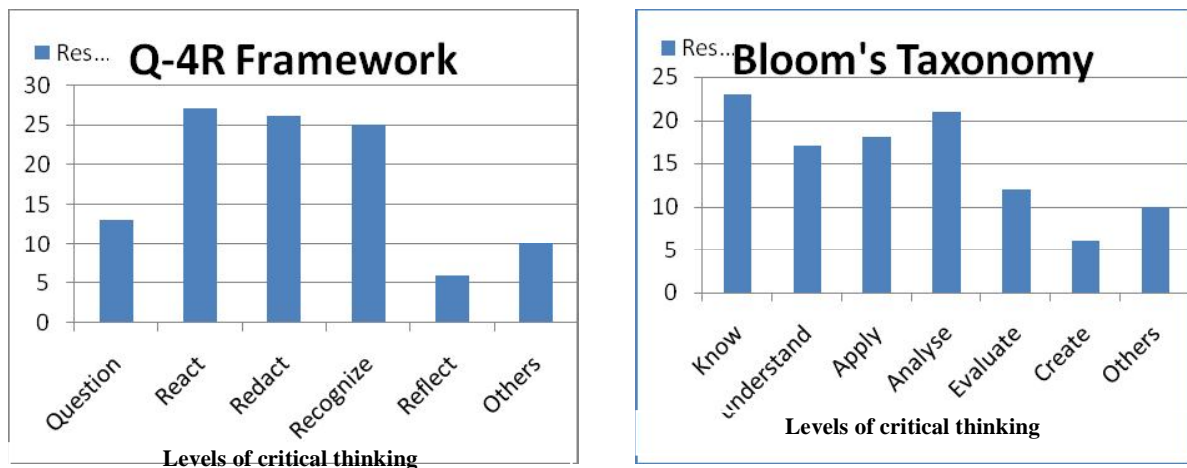


Figure 1: A comparison of higher-order thinking using the Q-4R framework and Bloom's taxonomy

It is observed from the above that the upper three levels (levels where critical thinking is said to occur) in Bloom's Taxonomy accounted for 33% of the overall discussions. The equivalent upper two levels of the Q-4R Framework accounted for 29% of the discussions. The process of categorization was instinctive and did not pose much of a problem to the reviewers. The flow of the discussion was easy to follow and model using the Q-4R Framework. A sample snapshot of the modeling of the forum discussion using guided facilitation is shown by the transition diagram in Figure 2. The transition diagram method was used as the modeling method as the representation of levels of the framework, the transition across the levels and the student who made the transition can be instinctively represented.

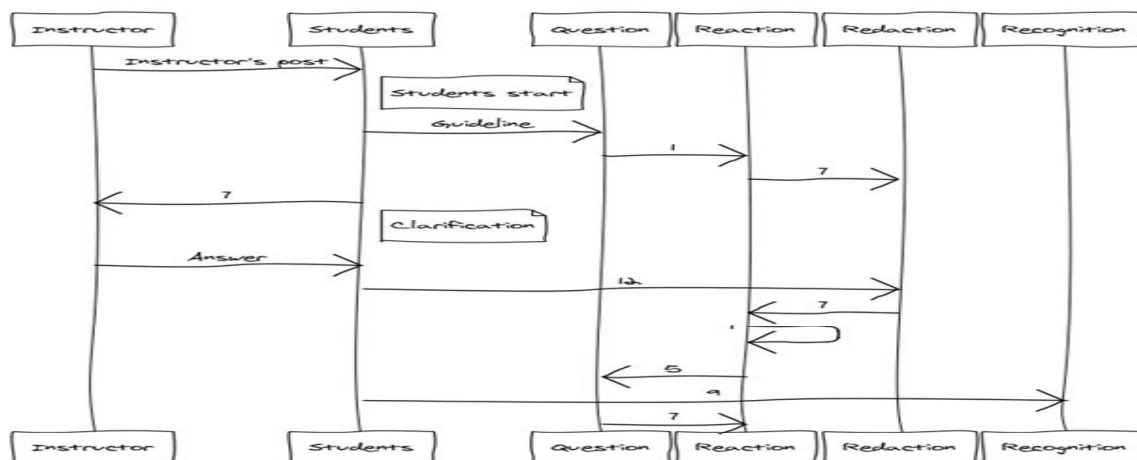


Figure 2: Transition diagram modeling of Q-4R framework

The process of discussion was guided and the task was to discuss the theories of learning and to give an example. The flow thus was an initial period of discussion, questioning, organization of thinking and then reflection. The arrows show the flow of the ideas from one post to the next. The label in the arrows is to identify the students. From Figure 2, it can be seen that Student 1 reacts to the question. The reaction is understood and built on by Student 7. Student 7 then raises a question to the instructor. The instructor clarifies....and this process goes on.

The distribution of the contents across the learners is shown in Figure 3. The scope of the discussion meant that the learners had to make a minimum of 3 postings. Some users did not achieve the minimum requirement of three postings. They had submitted forum posts that exhibited characteristics of critical thinking. This shows that consistent posting was not a prerequisite for critical thinking.

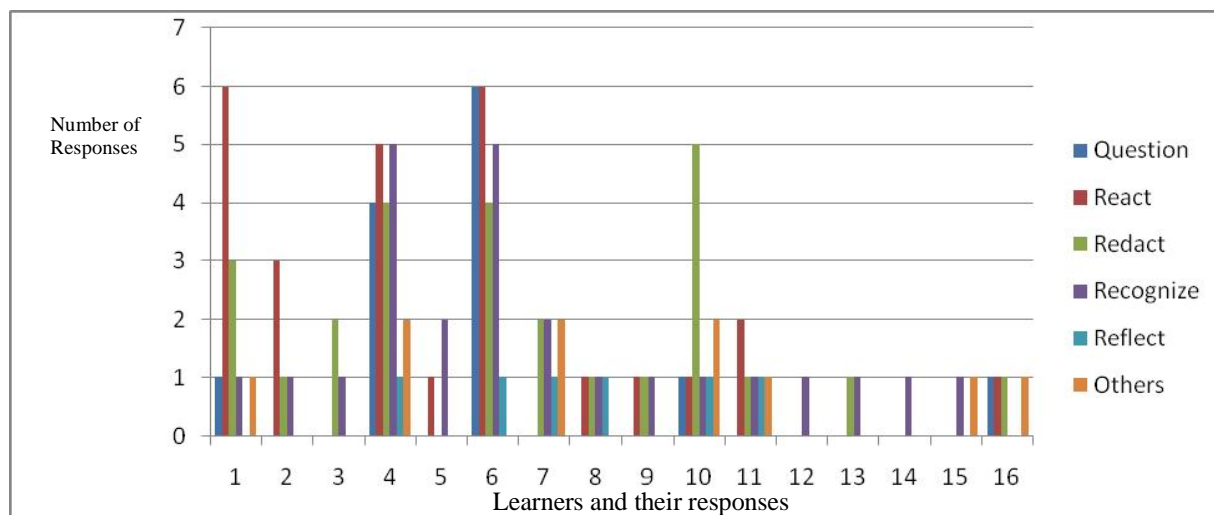


Figure 3: Q-4R framework – learner distribution

The flow of ideas was from one level to another and it was observed that predominantly for the first initial time period of 4 weeks, the discussions focused on lower levels of the frameworks. After the initial time

period, the discussions were predominantly on higher levels of the taxonomies. This behavior ties in well with the prevailing norms for online discussion. The learners took time to understand and assimilate the topics before forming their opinions on the task at hand. The other reason for this was the guidance of the instructors who encouraged the learners to focus on the initial task before finalizing their examples. Thus, the type of facilitation made a definite difference.

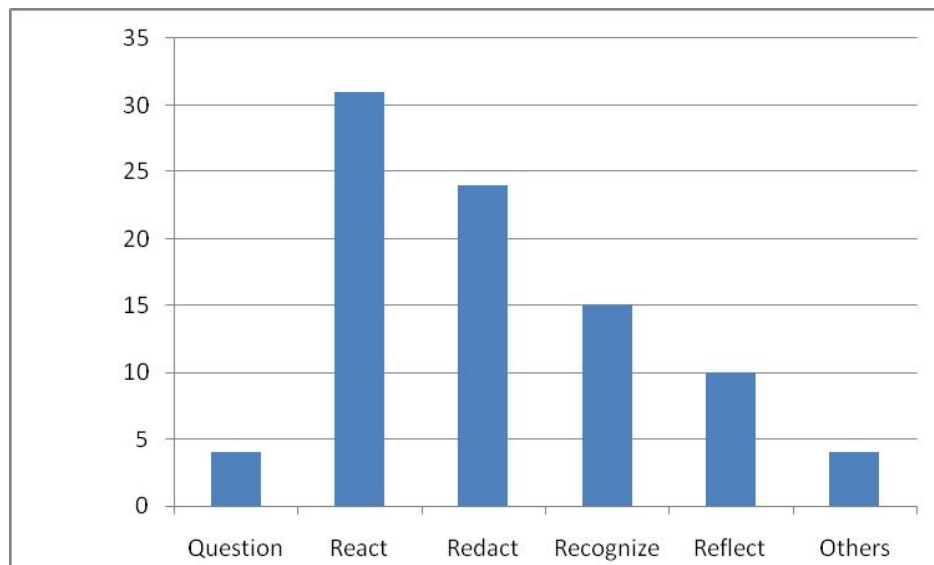


Figure 4: Q-4R framework distribution – open facilitation mode

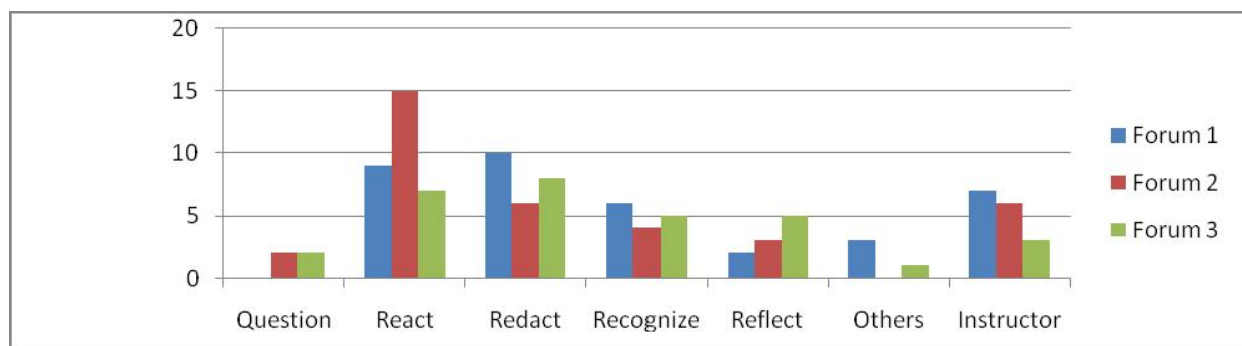


Figure 5: Q-4R framework distribution in terms of different forums – open facilitation mode

For the open facilitation mode, the flow of the Q-4R framework alone was traced and the transition diagram rendered. The forum consisted of three separate topic discussions. In this mode of facilitation, there were no ground rules in the facilitation at all. The Q-4R framework results for the three forum tasks are traced and shown in Figures 4 and 5. The results were consistent across the categories and showed miniscule differences. The students were facilitated with the same facilitator and worked on different topics. The mode of assessment was the same.

The first forum was traced using the sequence diagram (Figure 6). The instructor allowed the discussion to flow and intervened only when needed.

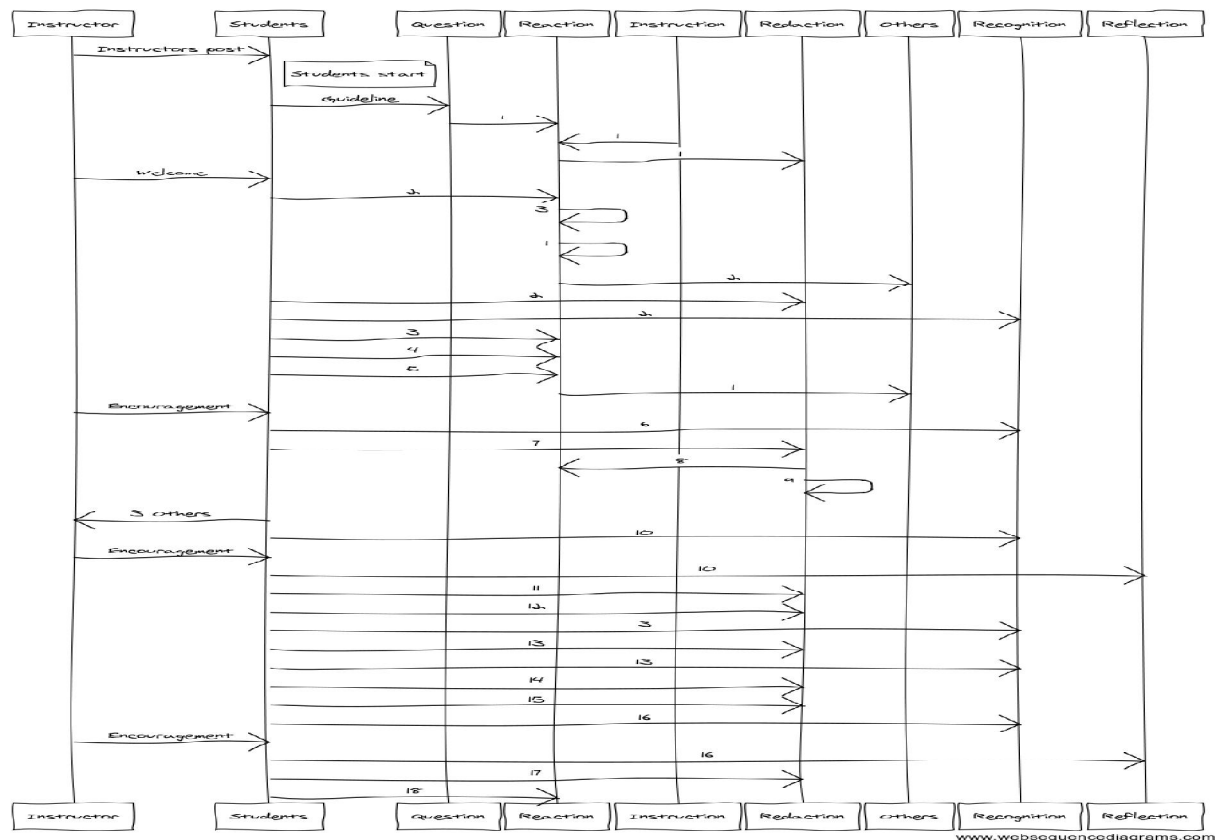


Figure 6: Complete transition modeling in terms of the Q-4R framework for a forum topic

The students were asked for their preference on the learning style (Figure 7). The sample size of responses was very small yet it was noticeable that the students preferred the open ended method. The qualitative responses are as below:

- *Student A: I would prefer to have both guided and open discussion methods in the facilitation as we, the online learners are very far from each other in a virtual class room and each of us came from a completely different cultural background.*
- *Student B: Open ended needs to guided into the marking scheme by the facilitator, specially in a purely online course.*
- *Student C: I preferred to be guided as the course was completely new to me.*
- *Student D: Open. But, a style that is suited to the context of the course.*
- *Student E: The open ended style was perfect for me as it presented an environment for learning outside the box to take place.*
- *Student F: I preferred a more open ended course because it provides learners with the opportunity to search resources that respond to their learning style and also foster learners' individual learning skills. Consulting other resources extensively pave the way for constructivism -constructing my own knowledge and skills by myself.*

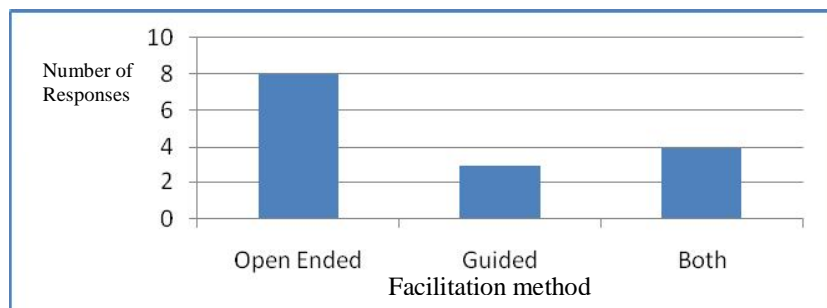


Figure 7: Student preferences about facilitation methods

The answer to the question of whether the learners could identify the facilitation method correctly was encouraging. Of the sixteen responses eleven students could identify the style accurately. Six out of nine students identified course 1 correctly. Five of out seven students correctly identified course 2. On the whole out of the 33 responses from students, 72% of responses accurately predicted the facilitation method.

Discussion

The first question considered is the applicability of the assessment frame working analyzing the patterns of interaction. How valid is it? How effective is it compared to the existing frameworks? The Q-4R Framework was derived out of Bloom's Taxonomy and was developed by considering personal insights and a range of literature in social cognitive theory, dialogic interaction and computer supported cognitive work. The framework was able to discern the patterns of interaction in a manner analogous to Bloom's conventional taxonomy. Higher- and lower-order thinking was adequately modeled in clear understandable layers. To validate this, the framework was presented to a neutral expert and insights derived. The framework represents several iterations out of real data and experiences of the authors in open and distance learning. Initially, the effort was in participatory, social and cognitive dimensions. This evolved into the framework as it exists now. The effectiveness is observed in the application as a method for future research.

The big difference between the open and guided discussion methods was the percentage of students who achieved critical thinking. The percentage of students who achieved critical thinking in open discussion mode (50%) was lesser compared to that of the guided discourse (68%). This was measured by comparing the number of unique students who achieved the critical thinking (Figure 4 and Figure 1) in the two facilitation models (open and guided). This is a contrast to the percentage of the number of posts which achieved critical thinking. More numbers of unique students could coalesce their thoughts into a coherent whole in the guided discourse tasks than the open discussion tasks. The explanation here could be that the forum discussions in the open discussion mode were split into segments or due to the other factors like time, facilitation style etc. But, in our view, there is a slightly more control in the guided discourse with more instructor intervention (20%) as opposed to the open facilitation (11%) and hence the results.

The definition of critical thinking in the facilitation models is another important factor. How do we verify that critical thinking was exhibited? By looking at the overall average numbers of student posts or looking at the percentage of students who have achieved the critical thinking? In our view, the percentage of

unique students who achieved the critical thinking must be considered as opposed to the overall numbers of forum posts. If we consider the overall numbers of forum posts signifying critical thinking, the content of a few active students with high critical thinking content could bias the facilitation model. For example, if the number of posts is 100 and the number of posts signifying critical thinking is 30, what does it signify? That 30 % of content is higher-order oriented? Now, assuming a class of 20 students and 10 of students alone contributed all the 30 of these critical thinking posts with reference to the task on hand, the numbers here suggest that 50% (10 students out of total 20 students) of the students have achieved critical thinking. Which number should be given more importance now – number of students achieving the critical thinking or the overall number of posts signifying critical thinking? In our view, models of assessment are with reference to the learner and not the overall content. Hence, this distinction (number of students achieving critical thinking as opposed to the number of posts exhibiting critical thinking) is very important. The key operative words are *with reference to the task on hand*. The critical thinking posts must be measured with reference to the given task. We do not however suggest that percentage of critical thinking posts is not important. They too are important as the total quantity of critical thinking posts signify the overall quality. But, allied to that, more emphasis is needed on the number of students achieving excellence.

The numbers suggest also that the critical thinking is linked to increased instructor presence. The students seemed to respond more to the questions/encouragement/explanation of the instructors. An interesting aspect of this work is its applicability to assessing the students.

Can the Q-4R framework be applied in the future as an assessment method? Meaning, could the facilitators use the Q-4R framework to assess the critical thinking in students and give them the feedback? Yes. The design of the Q-4R allows for the transition systems (Figure 6) to be built off the fly. Hence, an instinctive method that models the interactions can be used by the instructors. This will allow the identification of learners who are yet to reach the thresholds or levels easily and corrective action taken. On the whole, the application of the Q-4R framework for assessment is an avenue for future exploration. There was no visible pattern of interaction in the order of the discussions that could be inferred and correlated. Meaning, in this work we could not identify or analyze the cause-effect reactions. But, the patterns do exist especially in open facilitation models. This will be a part of our future work.

What is the role of the facilitator in the asynchronous discussion forums? Is it to enable the students to achieve critical thinking or collectively enable critical thinking to be achieved? Ideally a mix of both must be entertained. But, in this goal, how can the facilitator pursue the interaction? The challenge is to moderate the discussion in such a way that each and every student achieves critical thinking. Hence patterns of facilitation may need to be adopted. Here the key word is *adoption*. These facilitation models need to be linked with the patterns of assessment. A start has been made in this work, but, more work needs to be done.

Open ended facilitation models can benefit from clear rubric patterns. The problems students faced in the open ended facilitation model were in the closure aspect. When do the student know that they have achieved their goal and how does the facilitator ensure that they know? One mechanism that can be used is the use of social cues. Social cues are adjectives used for encouragement and participation. By framing the social cues carefully, the students can understand the goals clearly. Close ended facilitation models can emphasize the application aspects in their design. Use of examples can be encouraged and application in the student's own scenarios can be encouraged. The critical role is that of transparency. The facilitators can explain the guidelines for the forum discussion clearly. This ensures that the students understand their roles and responsibilities clearly.

The impact of the interaction in life-long learning is immense. The students were asked to express the purpose of the interaction in the forums. Some of the responses are as below.

- *Discussion helped examine alternatives and come up with clearer picture. Commenting on other peoples work helped understand for ourselves.*
- *I think it is wonderful to experience the interaction. Lots of new applications are discussed from learners' point of view and facilitators' interaction. Facilitators also guide us to be focused in the discussions to identify where we need more attention.*
- *Interacting with peers enable me to point of my views and share them with others and at the same time obtain some feedback from them to further enhance my understanding of a particular subject matter.*
- *I am normally interested to interact with peers, to see their views on certain topics.*

The students were categorical that the purpose of the interaction was for clarification, understanding, exposure to multiple cultures and understand the content in the course.

The students were asked as to the impact of the interaction for learning. Some of the responses are below:

- *The interaction between learners and facilitators must be maintained in order to identify and improve learning outcomes – this has been very good in the MIDT programme. The response from facilitators is prompt.*
- *Learners from different context share and exchange their knowledge on several issues in the interaction. This alone develops participants' knowledge and skills in those areas.*
- *Communication and support (feedback) Instructions should be clear and in this MIDT course I always knew what to do. With every assignment there were clear instructions and guidance. Regular support in the form of email communication occurred frequently and although we are far apart I never felt isolated or neglected.*

This work has shown clearly that the critical thinking of the learners is dependent on the mode of facilitation. Allied to this conclusion, the above two results are a snapshot of the relationship between the interaction and lifelong learning. The interaction paradigms must be clear, constructive and structured to have an overall effect on life-long learning. The interaction patterns are a product of the facilitation methods and in turn a reflection on the overall course. A course without a proper interaction forum will result in a feeling of alienation among the learners. A vibrant interaction forum provides scaffolding, period of togetherness and also improves the learning of the learners. Hence understanding the interaction patterns and focusing the research towards improving the critical thinking of the learners is a big need of the hour.

Conclusion

This work has sought to find the linkage between the interaction patterns and the facilitation methods in online asynchronous forum discussions. The results suggest that there exists a definite cause-effect linkage and that guided discourse resulted in an increase in critical thinking among students. For the assessment of critical thinking in asynchronous online discussions, a pedagogical assessment model called Q-4R framework has been proposed. The framework has been explained and applied for evaluating

around 200 forum posts of post graduate students. The framework has been compared with Bloom's Taxonomy in the assessment of the online discussions and it was found that the Q-4R framework can identify critical thinking in asynchronous online discussions. The implications of the study are in the linkages between the facilitation methods and critical thinking exhibited in online discussion forums. These can be pursued in the future.

References

- An, H., Shin, S., Lim, K. (2009). The effects of different instructor facilitation approaches on students' interactions during asynchronous online discussion. *Computers & Education*, 53, 749–760.
- Blanchette, J., (2011). Participant interaction in asynchronous learning environments: Evaluating interaction analysis methods. *Linguistics and Education*. doi:10.1016/j.linged.2011.02.007.
- Bliss, C. A., and Lawrence, B., (2009). From posts to patterns: A metric to characterize discussion board activity in online courses. *Journal of Asynchronous Learning Networks*, 13; 1-18.
- Dennen, V.P., (2008). Looking for evidence of learning: Assessment and analysis methods for online discourse. *Computers in Human Behavior*, 24; 205–219.
- Garrison, D. R., (2007). Online community of inquiry review: Social, cognitive, and teaching presence issues. *Journal of Asynchronous Learning Networks*, 11(1); 61-72.
- Hew, K.F., and Cheung, W.S. (2008). Attracting student participation in asynchronous online discussions: A case study of peer facilitation. *Computers & Education*, 51(3); 1111–1124
- Hou, H.-T., Chang, K.-E., and Sung, Y.-T., (2008). Analysis of Problem-Solving-Based Online Asynchronous Discussion Pattern. *Educational Technology & Society*, 11 (1); 17-28.
- Kaur, A., and Mansor, F., and Zoraini, W. A., (2010). Pure Online Learning: Pedagogical, Technological & Human Designs for Greater Access & Success. *6th Pan-Commonwealth Forum on Open Learning*, 24th - 28th November, Kochi, India.
- Marcelo, C., and Perera, V. H., (2007). Didactic interaction in e-learning: new styles for new environments. *International Journal of Continuing Engineering Education and Life Long Learning*, 17(6).
- Meyer, K.A., (2006). The method (and madness) of evaluating online discussions. *Journal of Asynchronous Learning Networks*, 10(4); 83–97.
- Meyer, K. A., (2008). Do rewards shape online discussions? *Journal of Interactive Online Learning*, 7 (2).
- Prasad, D. (2009). Empirical Study of Teaching Presence and Critical Thinking in Asynchronous Discussion Forums. *International Journal of Instructional Technology and Distance Learning*, 6(11).

- Rimor, R., Rosen, Y., and Naser, K., (2010). Complexity of Social Interactions in Collaborative Learning: The Case of Online Database Environment. *Interdisciplinary Journal of E-Learning and Learning Objects*, 6; 355-365.
- Schrire, S., (2006). Knowledge building in asynchronous discussion groups: Going beyond quantitative analysis. *Computers & Education*, 46; 49–70.
- Song, L., McNary, and S. W., (2011). Understanding Students' Online Interaction: Analysis of Discussion Board Postings. *Journal of Interactive Online Learning*, 10 (1).
- Swann, J., (2010). A dialogic approach to online facilitation. *Australasian Journal of Educational Technology*. 26(1); 50-62.
- L. Xin. (2008). Facilitating Asynchronous Interaction in the Online learning Community: Examining Five Types of Faculty Participation, *12th Global Chinese Conference on Computers in Education, GCCCE*.
- Yang, Y.-F. and Wu, S.-P., (2011). A Collective Case Study of Online Interaction Patterns in Text Revisions. *Educational Technology & Society*, 14 (2); 1–15.
- Zheng, M. and Spires, H., (2011). Teachers' Interactions in an Online Graduate Course on Moodle: A Social Network Analysis Perspective. *Meridian K-12 Computer Technologies Journal*, 13(2).